Citation:

Vang A, Singh PN, Lee JW, Haddad EH, Brinegar CH. Meats, processed meats, obesity, weight gain and occurrence of diabetes among adults: Findings from Adventist Health Studies. *Ann Nutr Metab*. 2008; 52 (2): 96-104.

PubMed ID: 18349528

Study Design:

Prospective cohort

Class:

B - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

POSITIVE: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To examine the relationship between all animal product consumption, specific animal product consumption (red meat, poultry, fish, processed meats, eggs, milk, cheese) and diabetes in adults.

Inclusion Criteria:

- Subject participated and had data available from both the 1960 Adventist Mortality Study and the 1976 Adventist Health Study
- Non-Hispanic white adults.

Exclusion Criteria:

Description of Study Protocol:

Recruitment

Members of the Seventh-day Adventist churches in California were recruited to participate in the study.

Design

Prospective cohort.

Dietary Intake/Dietary Assessment Methodology

Food-frequency questionnaire (FFQ) filled out by participants. Consumption was quantified as times per week.

Blinding Used

Not applicable.

Intervention

Not applicable.

Statistical Analysis

- Means or proportions of pertinent dietary intake and select lifestyle variables were calculated for categories of meat intake
- Multivariate regression analysis was used to relate consumption of animal products to diabetes (dicotomous variable). For each dietary variable, the overall significance of the individual food variables was estimated with a log-likelihood ratio test of the indicator food variables. In addition, a multivariate test for the linear trend across food intake levels was performed for each dietary variable. Confounding by other control variables was tested by adding the variables to the multivariate models. Subsequent evaluation of the multivariate models included excluding subjects with diseases that may have impacted dietary choices, such as subjects with cardiovascular, stroke or cancer
- Dietary indices created for the study were validated in a sub-study (N=147) that correlated the meat intake with five 24-hour recall questionnaires.

Data Collection Summary:

Timing of Measurements

Data was collected from study participants by questionnaire at the beginning (1960) and conclusion (1976) of the study.

Dependent Variables

Incident diabetes: Based on data collected from the health history portion of the study questionnaire.

Independent Variables

- Animal product consumption including: red meat, poultry, fish, eggs, cheese, milk and processed meats (frankfurters and salted fish)
- Consumption of animal products was broken down into indices of consumption all animal products; all meats; all processed meats; consumption of milk; consumption of eggs
- Using these indices, subjects were categorized as vegetarian (those who did not consume meat), individuals who consumed meat occasionally (less than once per week), and non-vegetarian (those who consumed meat once or more a week)
- Long-term vegetarian status was determined by cross-classifying subjects based on data at both time points of the study
- Consumption was measured using food frequency reported at the inception and conclusion of the study.

Control Variables

- Age
- Gender
- Body mass index (BMI)
- Smoking status (based on questions regarding use of cigarettes, cigars and pipes)

- Alcohol consumption (beer, wine, liquor combined)
- Education
- Prevalent disease history (heart disease, stroke, cancer)
- Physical activity (based on 1976 survey responses to questions regarding leisure time and occupational activities).

Description of Actual Data Sample:

- *Initial N:* 8,401
    - 4,899 males
    - 3,502 females
    - 3,994 vegetarians
    - 3,798 weekly meat eaters
    - 224 occasional meat eaters
    - 385 no response
- *Attrition (final N):*
- *Age:* Adult; Mean age:
    - 66 for vegetarian and occasional meat intake groups
    - 63 for non-vegetarian group
- *Ethnicity:* White, non-Hispanic
- *Other relevant demographics:*
- *Anthropometrics:* Participants within the non-vegetarian group had a higher prevalence of cigarette smoking, alcohol use and fewer years of education compared to the vegetarian and occasional meat intake groups
- *Location:* California, USA.

Summary of Results:

- During the 17-year follow-up, 543 incident diabetes cases were identified
- Participants who were weekly consumers of all meats (red meat, poultry, fish) were 29% more likely relative to zero meat intake to develop diabetes (OR=1.29; 95% CI: 1.08, 1.55)
- An increase in risk for weekly intake of red meat and poultry (OR=1.27; 95% CI: 1.06, 1.53), but not for weekly intake of fish (OR=1.12; 95% CI: 0.88, 1.44) was observed
- Subjects who consumed any processed meats (salted fish and frankfurters) were 38% more likely to develop diabetes than those who did not consume any processed meats (OR=1.38; 95% CI: 1.05, 1.82)
- Long-term adherence (over the 17-year interval) to a diet that included at least weekly meat intake was associated with a 74% increase in odds of diabetes relative to long-term adherence to a vegetarian diet (zero meat intake) (OR=1.74; 95% CI: 1.36, 2.22)
- Further analyses indicated that some of this risk may be attributable to obesity or weight gain–both of which were strong risk factors in this cohort
- Even after control for weight and weight change, weekly meat intake remained an important risk factor (OR=1.38; 95% CI 1.06-1.08) for diabetes.

Author Conclusion:

The authors concluded that meat intake, particularly processed meats, is a dietary risk factor for diabetes.

Reviewer Comments:

- *The small percentage of people consuming processed meats, particularly those consuming salted fish, raises the question of false positives*
- *The study does not distinguish type 1 and type 2 diabetes, although the etiology can be quite different. In addition, it may have been informative to examine red meats separately from poultry*
- *P-values for the long-term dietary pattern analysis does not seem to be reported.*

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions		
1.	Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies)	Yes
2.	Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about?	Yes
3.	Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice?	Yes
4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	Yes

Validity Questions		
1.	**Was the research question clearly stated?**	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	**Was the selection of study subjects/patients free from bias?**	Yes
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	Yes

2.4.	Were the subjects/patients a representative sample of the relevant population?	???
3.	**Were study groups comparable?**	Yes
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	N/A
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	N/A
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	N/A
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	Yes
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	N/A
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	**Was method of handling withdrawals described?**	N/A
4.1.	Were follow-up methods described and the same for all groups?	N/A
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	N/A
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	N/A
4.4.	Were reasons for withdrawals similar across groups?	N/A
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	**Was blinding used to prevent introduction of bias?**	???
5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	N/A
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	N/A
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	???

5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	**Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were interveningfactors described?**	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	N/A
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	N/A
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	Yes
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	Yes
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	N/A
6.6.	Were extra or unplanned treatments described?	N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	Yes
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A
7.	**Were outcomes clearly defined and the measurements valid and reliable?**	Yes
7.1.	Were primary and secondary endpoints described and relevant to the question?	Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	Yes
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	Yes
7.5.	Was the measurement of effect at an appropriate level of precision?	Yes
7.6.	Were other factors accounted for (measured) that could affect outcomes?	Yes
7.7.	Were the measurements conducted consistently across groups?	Yes
8.	**Was the statistical analysis appropriate for the study design and type of outcome indicators?**	Yes
8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes

8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	N/A
8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	Yes
8.6.	Was clinical significance as well as statistical significance reported?	Yes
8.7.	If negative findings, was a power calculation reported to address type 2 error?	N/A
9.	**Are conclusions supported by results with biases and limitations taken into consideration?**	Yes
9.1.	Is there a discussion of findings?	Yes
9.2.	Are biases and study limitations identified and discussed?	Yes
10.	**Is bias due to study's funding or sponsorship unlikely?**	Yes
10.1.	Were sources of funding and investigators' affiliations described?	Yes
10.2.	Was the study free from apparent conflict of interest?	Yes